

Holocene climate change along the Chilean margin as determined by beryllium isotope analysis

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The Chilean coast is a key region with regards to global climate change and the carbon cycle. The Southern westerly wind belt (SWW) is currently positioned in central Chile (40°S-60°S) along with the Antarctic Circumpolar Current (ACC). The SWW controls the position and the strength of ACC and together they play an important role in controlling atmosphere-ocean coupling phenomena. When the SWW and the ACC are enhanced, more surface water is deflected allowing more carbon rich deep water to upwell, resulting in the release of CO₂ to the atmosphere. As such, the SWW and the ACC, which are positioned over the Pacific offshore Chile, are key components of global climate change.

During the Holocene, the SWW was relatively weak before ~8 ka, strengthening after ~8 ka in both the western and eastern sector of the Pacific. However, higher resolution records would allow for a more complete understanding of latitudinal variability of the SWW and the impacts of future global warming on this region of the world.

The cosmogenic radionuclide ¹⁰Be (T_{1/2} = 1.39Myr; Chmeleff et al. 2010) is produced by the interaction of cosmic rays with oxygen and nitrogen in the atmosphere, and deposited onto the Earth's surface via precipitation or dust. The stable isotope ⁹Be is present in silicate rocks and is released to rivers during chemical weathering. An advantage of using the ratio of ¹⁰Be to ⁹Be (¹⁰Be/⁹Be) is the removal of secondary effects (e.g. grain size effect). As ¹⁰Be is produced in the atmosphere, beryllium isotope will be a useful proxy to reconstruct ocean-atmosphere coupling phenomena during the Holocene.

Here, we measure authigenic beryllium isotopes in marine sediment core from offshore Chile with exceptionally high sedimentation rates (~3 mm/yr) to reconstruct Holocene variation in the SWW and the ACC during the Holocene. The beryllium isotope records show a two-step increase at 8.2 ka and 4.2 ka, which is the result of an increase in the upwelling of ¹⁰Be rich deep water. When compiled with data from previous studies, this increase in upwelling is likely driven by enhanced ACC strength during the Holocene.

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